MPA material matters

August 2006

Newsletter of the Materials Physics and Applications Division

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Celebrating CINT

CINT Gateway to Los Alamos dedicated

The Center for Integrated Nanotechnologies' Gateway to Los Alamos Facility was officially dedicated August 21. Attending the ceremony were U.S. Senators Pete Domenici, R-N.M., and Jeff Bingaman, D-N.M., Deputy Secretary of the U.S. Department of Energy Clay Sell, and Altaf Carim of the Office of Science/Basic Energy Sciences, as well as more than 100 invited guests from the federal and state government, Department of Energy, National Nuclear Security Administration, and Los Alamos National Laboratory.

Jointly operated by LANL and Sandia National Laboratories, CINT is a Department of Energy/Office of Science Nanoscale Science Research Center and national user facility devoted to establishing the scientific principles that govern the design, performance, and integration of nanoscale materials.

The 36,500-square-foot CINT Gateway to Los Alamos Facility features roughly 11,000 square feet of laboratory space dedicated to chemical and biological synthesis and characterization, biomaterials fabrication and characterization, optical microcopy and spectroscopy, physical synthesis, thin-film fabrication, spatially resolved scanned probe characterization, and advanced computation. It houses Lab scientists, postdoctoral researchers, technical support staff, and visiting researchers.

The CINT Core Facility in Albuquerque was dedicated August 23.

Through its Core Facility and Gateways to both Los Alamos and Sandia, CINT provides access to the tools and expertise needed to explore the continuum from scientific discovery to the integration of nanostructures into the micro- and macro worlds.

U.S. Senators Pete Domenici, R-N.M., and Jeff Bingaman, D-N.M., joined Laboratory Director Mike Anastasio, center, in cutting the ribbon at Los Alamos' Center for Integrated Nanotechnologies. At far left are Toni Taylor, associate director of CINT, and Clay Sell, Department of Energy deputy secretary, Far right is Al Romig, vice president of Sandia National Laboratories.

Exceptional students honored at symposium awards banquet

The outstanding achievements of students in the Materials Physics and Applications and Materials Science and Technology Divisions were honored at an awards banquet, the culmination of the "Symposium 2006: Highlighting Student and Postdoctoral Research," held recently at the University of New Mexico, Los Alamos.

MPA-CINT's Nesia Zurek was recognized as a distinguished student. Nominated by her mentor Gabe Montano, Zurek has been a Los Alamos National Laboratory student for seven years and worked on projects that ranged from materials science to biology.

Nesia Zurek

MPA-CINT's Montano said what most impressed him about Zurek was her "combination of courage, tenacity and self motivation." Able to count on Zurek's willingness to confidently take on research projects, Montano said Zurek has over the years "become more independent to the point where her research capabilities are those of a well-seasoned graduate student." This summer her research focused on engineering novel lipid membrane structures.

Zurek has also been an active member of the Student Programs Advisory Committee and helped organize the Student Association's Annual LANL Student Picnic. Zurek "jumped right on in to help" when one of the committee's mem-

"Students" continued on page 6

From John's desk...

Materials Physics and Applications: Good news

As summer winds down and we look toward a new fiscal year in October that will certainly include some challenges, I want to focus this month on good news—it doesn't take much looking to find quite a lot of positives in the Division.

Let me first address the cost of doing business. I know that a number of you are concerned about tax rates, especially as the Laboratory attempts to absorb new costs associated with gross receipts tax, the increased management fee, and costs associated with the new retirement system. While these costs are real, it is worth noting that significant efforts to reduce both infrastructure/facility and directorate overhead tax rates are also underway. It's too early to report a final answer for FY07, but I share Terry Wallace's optimism that we'll end up with overall tax burden much closer to the current state than many people believe.

The outcome of the FY07 LDRD process was recently announced, and MPA Division did remarkably well—so well, in fact, that coming up with a complete tabulation of our wins is difficult. We are the principal investigators (PIs) on two LDRD-DR projects (led by Rick Averitt and Joe Thompson) and play essential supporting roles in several others, including Steven Graves' and Jeremy Mitchell's) and we lead no less than seven LDRD-ER projects.

I'm quite proud of these successes not only because of their sheer number but also because they span the full breadth of our technical diversity. Current estimates indicate that we will have either the largest or second largest LDRD portfolio in the Laboratory. In future months I will discuss my views on LDRD and how we can best execute a set of projects that builds on the successes and innovation of our PIs while allowing clear focus areas to emerge.

Within the last two weeks, MPA played a key role in the visit of the Japanese Minister for Economy, Trade, and Industry (one of the most senior Cabinet-level positions within the Japanese government); we have officially dedicated our Center for Integrated Nanotechnologies both at LANL and in Albuquerque; we've set several world records for high magnetic fields; and MPA scientists will be announced shortly as the winners of the Technology Transfer Division "IDEAS" awards. And that's just recently.

Although it's sad to see summer go so quickly, I think the fall gives us a particular opportunity to clarify our strategic objectives and focus on defining MPA's core values and objectives. Every indication is that we'll have more work to do than people to do it, which will lead to continued growth in the Division as well as further opportunities to team and partner with colleagues across the Laboratory. I look forward to discussing the details of these opportunities with you in group meetings and/or informally

Finally, a word on safety. In previous notes I've discussed personal safety plans and my own struggle to come up with one that I thought made sense. I'm happy to announce that I now have one, and I'd welcome your asking about it and how I'm doing in meeting these goals.

— John Sarrao, MPA Division Leader

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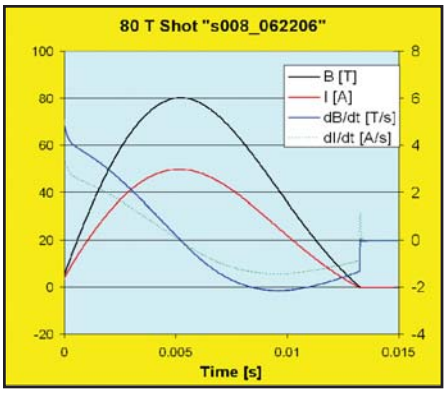
Celebrating service

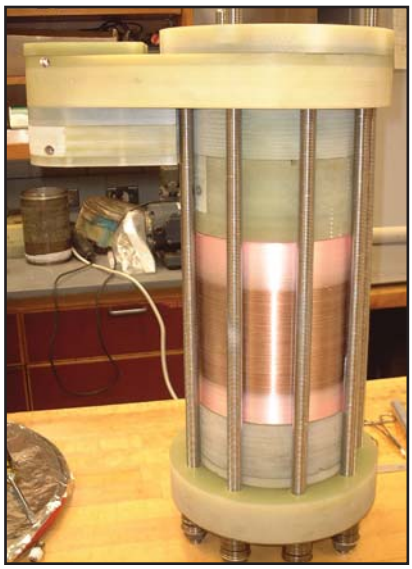
Magnet Lab pulsed magnet achieves 80-tesla operations

The National High Magnetic Field Laboratory's Pulsed Field Facility newly developed pulsed-magnet prototype recently survived multiple shots at 80 tesla.

The 80-tesla model coil, in operational evaluation at LANL's Pulsed Field Facility, will be useful in determining operating parameters for the Department of Energy-National Science Foundation 100 Tesla Multi-Shot magnet program. Several other labs worldwide have attempted to deliver similar systems without success.



Above, record of 80 T waveform. At right, image of 80 T prototype magnet after assembly. The inner coil is constructed with materials & techniques identical to those in use for the 100 T insert program.



Testing intended to establish the limits of the present generation of pulsed magnet technology by pulsing the coil to destruction, started on June 15. The magnet attained 80-tesla operations June 22. The prototype experienced a fault the evening June 26.

The development of the 80-tesla model coil was a team effort that required close coordination between the Los Alamos and Tallahassee, Fla., sites of the lab. LANL MPA-NHMFL team members include Mike Gordon and Alan Paris, bank operations; James Michel, technical winding support; Mike Pacheco, component fabrication and test setup; Dwight Rickel, magnet testing; Josef Schillig, capacitor bank design; and Jeff Martin, diagnostics. Florida team members include: Bill Sheppard, technical winding; Todd Adkins, Tooling CAD; Scott Bole, engineering manager; Mark Collins, coil machinist; Steve Kenny, Magnet CAD; Ed Miller, technical winding; Ken Pickard, coax leads and material coordination; and Robert Stanton, welding.

"The lab's engineers and technicians continue to set the world standard for magnet technology," said Alex Lacerda, MPA-NHMFL center leader and NHMFL associate director for user operations. "We look forward to giving our users routine access to pulsed fields that in the past could only be imagined."

Once completed, the magnetic field of the 100 Tesla Multi-Shot system will provide routine non-destructive access to stronger thermodynamic effects than any other thermodynamic variable but temperature.

Moreover, the 100's millisecond measurement times will permit the application of a wide variety of experimental probes including spectroscopy (continuous and time-resolved), transport and possibly thermodynamics.

New insight into generating hydrogen-rich fuel-cell feeds from dimethyl ether

Recent research by members of MPA-MC and MPA-11 studying hydrogen-rich fuel-cell feeds from dimethyl ether (DME) provides new insight into the potential development of bifunctional catalysts suitable for the production of hydrogen-rich fuel-cell feeds from dimethyl ether steam reforming.

Hydrogen generation from dimethyl ether is of importance because dimethyl ether can be produced from a wide variety of feedstocks (coal, biomass or natural gas), thus increasing our energy security by displacing petroleum derived fuels. One advantage (among others) of dimethyl ether as compared to other alternative fuels (i.e., methanol, ethanol, Fischer-Tropsch fuels, biodiesel, etc.) is that DME is a multipurpose fuel (i.e., diesel fuel, cooking and heating fuel, and a low temperature reforming fuel for hydrogen production).

Additional information on dimethyl ether as compared to other alternative fuels can be found in "Dimethyl ether (DME) as an alternative fuel," by T. Semelsberger, R. Borup, and H. Greene *Journal of Power Sources* **156** (2005), one of the top ten most downloaded articles from July 2005 to March 2006.

The researchers investigated steam reforming of DME for generating hydrogen-rich fuel-cell feeds over a series of incipient wetness prepared and co-ion exchanged catalysts containing copper and zinc. All zeolite-supported catalysts had poor activity toward hydrogen production. Incipient-wetness prepared Cu/Zn/ -Al2O3 was the overall best performing DME-steam reforming catalyst. However, the high temperatures needed for the hydrolysis of DME to methanol (MeOH) may prevent -Al2O3 from being an acidic support for copper and zinc. Because of the increased activity for the hydrolysis of DME to MeOH over Brønsted sites (as compared to Lewis sites), the most promising solid-acid supports for the low temperature hydrolysis of DME to MeOH are zeolites.

The work, "Generating hydrogen-rich fuel-cell feeds from dimethyl ether using Cu/Zn supported on various solid-acid substrates," to be published in an upcoming issue of Applied Catalysis, A is by Troy Semelsberger, Kevin Ott, MPA-MC; Rodney Borup, MPA-11; and Howard L. Greene Case Western Reserve University.

The work was partially supported by the US Department of Energy, Hydrogen, Fuel Cells and Infrastructure Program, and by Los Alamos Laboratory Directed Research and Development.

Heads UP MPA!

Requirements for reading, obeying radiological signs, postings

The importance reading and understanding radiological postings cannot be overemphasized. Radiological workers' actions directly affect contamination control and personnel radiation exposure to themselves and coworkers.

Radiological signs and postings exist to provide information on area conditions, personal protective equipment and other requirements necessary to enter a radiological area. As workers become accustomed to seeing signs and postings in their work areas, it can become common practice to walk past them assuming they know the area conditions, requirements and what is posted. It is important to read these signs and postings every time upon entering a radiological area because area conditions can change and the postings are updated to provide current information and requirements.

This requirement is specifically stated in LIR402-700-01.2., Occupational Radiation Protection Requirements, section 6.3 and 6.31: "All employees shall obey posted, written, and oral radiological control signs, labels, and instructions; hazard control plans (HCPs); and procedures, including instructions on radiological work permits."

Additionally, it is important to know that RPT-1, whose members are radiological control technicians, is the only organization authorized to install, take down, or modify a radiological posting or sign. If employees have any questions regarding the information or requirements on a radiological posting or sign they should contact RPT-1, before entering the radiological areas.

Ladder safety

Four rules cover safe use of ladders.

- Pick the right ladder for the job you are going to do.
- Make sure the ladder is in good condition – never use a damaged or defective ladder.
- Set up the ladder correctly.
- Work safely on the ladder. Avoid the top step - your waist should be no higher than the top step of the ladder.

For a detailed look at ladder safety, see http://int.lanl.gov/orgs/adeshq/safety_smart.shtml and click on the Safety Smart Log In, then select "Ladder Safety" from the left hand column.

Remember: ladder safety training (course 12985) is required for any employee who is required to climb a ladder.

Safety Short—human numbers

A new Safety Short series of timely topics is available to help Laboratory employees stay safe at work and at home.

The first, "Human Numbers," focuses on what Laboratory safety numbers really mean.

It describes the total recordable case monthly rate in human terms. It also shows how many are injured, develop illnesses, or receive first aid as a result of work.

To download the Safety Short flier, go to http://int.lanl.gov/safety/safetyshort/humannumbers/flier.pdf.

To view the one-minute Safety Short video, go to: http://int.lanl.gov/safety/safetyshort/humannumbers/safety_short_anim.mpg.

All of these materials can also be found at: http://int.lanl.gov/safety/safetyshort/.

Wildlife sightings

Wildlife sightings at the Laboratory are not uncommon. For the safety of all involved, a few precautions will help keep an encounter from turning bad.

- Stay aware of your surroundings so you can spot an animal before coming too close to it.
- Stay calm. aware.
- Treat wild animals with respect and help watch out for Lab visitors who may not be familiar with the dangers of local wildlife.

Report potentially dangerous wildlife encounters or sightings to James Biggs at 5-5714 or Leslie Hansen at 5-9873.

If attacked or bitten, immediately seek medical attention and contact Emergency Response at 911 or 7-6211.

Heads UP, MPA! reports on environment, safety, and health, security, and facility-related news and information.

MPA-10 thermoacoustics team demonstrates continuous separation of binary mixture

In thermoacoustic mixture separation, a sound wave propagating in a gas mixture in a tube causes one component of the mixture to flow in the sound-propagation direction and the other component to flow in the opposite direction. The expenditure of acoustic power results in an increase in the Gibbs free energy of the mixture's components, and the energy efficiency of the process is comparable to that of some other practical separation processes such as gaseous diffusion.

In the team's most recent advance, they demonstrated continuous separation of a binary mixture, instead of previous batch separations. Feedstock flows steadily into the separation tube, while two product streams—one enriched in the heavy component and the other in the light component—flow out. Measurements are in excellent agreement with calculations having no adjustable parameters.

The work is part of an LDRD exploratory research project and advances the thermoacoustic research that has been taking place in MPA-10 for more than two decades.

Taking part in the research were Greg Swift, Scott Backhaus, both MPA-10, Drew Geller, AET-3, with technician support from Mike Torrez, Carmen Espinoza, and Chris Espinoza, all from MPA-10.

Check out MPA on the Web

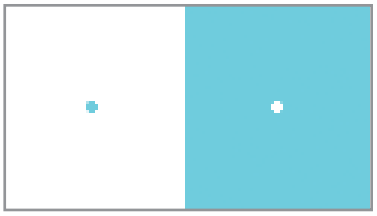
Visit the new MPA Web site at http://int.lanl.gov/orgs/mpa/index.shtml

LANL workshop probes dual nature of f-electrons

Researchers from around the globe gathered in Santa Fe last week to confront one of the most challenging questions in modern condensed matter physics—the dual nature of f-electrons.

Presenting the current state of research and facilitating discussion focused on the dual nature of f-electrons in a multitude of systems the First International Workshop on the Dual Nature of f-Electrons was sponsored by Los Alamos National Laboratory's Seaborg Institute and the Laboratory Directed Research and Development program, and the Department of Energy's Office of Science and Office of Basic Energy Sciences.

The dual nature of f-electrons may be seen differently, depending on the use of experimental or theoretical techniques,



First International Workshop on the Dual Nature of f-Electrons

but, in general, it manifests itself in the ability of f-electrons to be simultaneously localized and itinerant (band-like) in the same system. Several experiments and some theory argue precisely for this seemingly contradictory duality. Los Alamos National Laboratory is a leader in f-electrons research, including the various aspects of duality.

The workshop drew 35 national and international scientists who participated in invited talks and roundtable discussions aimed at a better understanding of the physical consequences of duality. This understanding has the potential to change the conceptual framework of the physics of strongly correlated materials.

Organizers were Tomasz Durakiewicz, MPA-10, and Cristian Batista, T-11. Co-organizer was Gertrud Zwicknagl of Germany's Technische Universität Braunschweig.

Organizers intend to continue the workshop biennially.

More information about the workshop, including program and speakers, may be found at: http://public.lanl.gov/tomasz/dual/dual.html.

MPA-11 researchers discover unique aspects of noble metals spontaneously deposited on hexaborides

Francisco Uribe and co-workers within the fuel cell team of MPA-11 have discovered that rare-earth and other metal hexaborides possess the unusual ability to spontaneously deposit noble metals from solution without the need for separate reducing agents or pretreatments.

The hexaborides are commonly known for their refractory properties, high electronic conductivity, and low work function, and thus are frequently used as thermionic emitters. The discovery was made upon investigating hexaborides as catalyst supports to ideally maintain the stability and dispersion of platinum nanostructures in an electrochemical environment, a challenge with current catalysts. Indeed, full and uniform coverages of hexaboride powders are obtained even with spontaneous depositions only ca. 1 nm thick. Such deposits of platinum on in-house synthesized hexaboride supports with ca. 1m2/g surface area are shown to maintain electrochemical activity in acidic media despite the low dimensional order of the catalyst. To sustain the activity and dispersion of this noncrystalline platinum, the hexaboride support appears to have unusual promotion and adhesion qualities, possibly due to the low work function of the material.

Of possible interest for other (non-catalyst) applications, much thicker spontaneous depositions are easily and quickly achievable. For example, mirror-like, uniform and strongly adherent metal films on lanthanum hexaboride sputter-coated glass can be spontaneously formed in a minute or two. Consequently, the materials may also be useful for optic, electronic, or thermionic applications. Initial results were reported at the Fuel Cell Program Annual Review and a patent application has been submitted.

In addition to Uribe, researchers include Mahlon Wilson, Fernando Garzon, Eric Brosha, Christina Johnston, and Judith Valerio, all MPA-11, and Steven Conradson, MST-8. The work was sponsored by the DOE-Hydrogen, Fuel Cell and Infrastructure Technologies Program.

Fuel cell catalyst validation test completed

At the request of the DOE Office of Hydrogen, Fuel Cells & Infrastructure Technologies and the U.S. Council for Automotive Research Freedom Cooperative Automotive Research Fuel Cell Technology Team (representing Ford, GM & DaimlerChrysler), MPA-11 characterized and tested in a fuel cell a tungsten-based non-precious cathode catalyst widely heralded by the developer.

LANL characterization showed that the beginning material was not as advertised and that the developer's "special" activation procedure dissolves platinum from the anode and causes it to migrate to the cathode where it re-deposited, providing oxygen reduction activity. This independent validation effort, performed under our standing task for "Technical Assistance to Developers," is crucial to ensuring that DOE program managers and stakeholders have valid data for decisions.

Got news?

MPA Material Matters features technical highlights developed each week for the Director's Office.

If you have unclassified news you'd like to see featured, please send it to your group leader to be forwarded to *MPA Material Matters* Editor Karen Kippen.

"Students" *Continued from page 1*

bers had to quickly depart for medical school, said Carole Rutten, team leader for the student internships program of the Science and Technology Base Program Office.

Rutten described Zurek as "very action oriented," having "an inquisitive mind" and "being such a pleasure to be around …because she has such a kind personality." Zurek eventually was given the title of Students' Association member at large for the assistance she offered. She begins graduate school this month in the Molecular Cellular and Developmental Biology Department of the University of Colorado at Boulder.

MPA-STC postdoctoral researcher Jens Haenisch was recognized with an outstanding postdoctoral presentation award for his talk on "Angular Dependent Critical-Current Measurements on long High-*Tc* Superconductor Tapes." The work, which featured the development of a new magnet rotator for measuring anisotropies in long samples of superconductor tapes was performed together with Yates Coulter, MPA-STC. Mentored by MPA-STC's Vladimir Matias, Haenisch earned his doctorate at the Leibniz Institute for Solid State and Materials Research in Dresden, Germany. The researcher is interested in developing improvements to superconducting tapes.

For his technical talk on "In-situ Neutron Diffraction Studies of YCu Using SMARTS," MST-8 student Scott Williams won a Symposium 2006: Championing Scientific Careers Award for an outstanding presentation in materials science. A doctoral student at Iowa State University, Williams is a Laboratory graduate research assistant mentored by Don Brown, MST-8. At Los Alamos, Williams worked with the Spectrometer for Materials Research at Temperature and Stress (SMARTS) at the Los Alamos Neutron Science Center's Lujan Center. Williams is interested in using neutron diffraction to study deformation mechanisms in ductile rare earth intermetallics.

Daniel Rogers, an MST-8 affiliate, earned a symposium award for his outstanding materials science poster. A Department of Homeland Security graduate fellow working with MST-8's Marilyn Hawley and Geoff Brown, Rogers received his award for his poster on "Optical Detection of Entanglement in Solid-state Qubits." A third-year graduate student in the chemical physics program at the University of Maryland, Rogers spent a 10-week internship at Los Alamos, which he described as a change of pace from his graduate research work in quantum cryptography at the National Institute of Standards and Technology in Gaithersburg, Maryland.

From left are new Students' Association officers Emily Schultz, secretary; Jake Meadows, chairperson; Kitty Cha, vice-chairperson; and Rachel Condie, treasurer.

Scott Williams

Jens Haenisch

Also during the banquet, new Students' Association officers were named, including Kitty Cha,MPA-CINT, as vice-chairperson. Cha is a post-baccalaureate undergraduate student working with Elshan Akhadov on fabrication of materials for use in gamma ray channeling experiments. She earned her bachelor's degree from California's Scripps College, where she majored in chemistry. As the association's vice-chairperson, Cha said she hopes to "bring a lot of new ideas to the team and increase the amount of student involvement and engagement, especially during the school year."

The annual symposium, organized by STB, was intended to broaden students' and postdoctoral appointees' expertise and prepare them for careers in science and non-technical fields.

— By Karen Kippen

Underground Radio™ revolutionizes subterranean emergency rescue capabilities

A Laboratory developed technology may soon help save lives of people trapped in underground accidents. The Laboratory signed licensing agreements with Vital Alert Technologies Inc. for Los Alamos' Underground Radio™, a technology that will provide Through-The-Earth Communication™, (two-way voice and text) for first responders, rescue and security teams, underground miners, and the public in critical emergency situations around the world.

Underground Radio uses very low frequency (VLF) electromagnetic radiation and digital audio compression technology to carry voice and text data. The VLF signals also can transmit tracking and location data for radio users if they are unable to respond.

"This is a technical solution to the problem of voice communication in underground areas. It also is inexpensive to build," said MPA-STC's David Reagor, principal investigator of the team which originally developed the technology.

Underground Radio provides two-way voice reception that can be used to alert individuals of underground conditions during blasts, fires or collapses, or to locate trapped miners. The technology provides convenient, portable underground communication and a data link to robotic machines. *— By Hildi Kelsey*